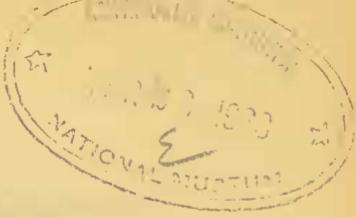


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THE CACTACEAE OF THE GALAPAGOS ISLANDS

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FOREWORD

The *Cactaceae* of the Galapagos Islands are among the most interesting plants of the archipelago, not only scenically because of their size and aspect but also botanically because of their peculiar morphologic characters and local distribution. This study on their taxonomy has been based mainly on the collections obtained by the Templeton Crocker Expedition of the California Academy of Sciences and by Alban Stewart, botanist on the Academy Expedition of 1905-1906. Through the kindness of Dr. J. M. Greenman, it has been possible to study critical specimens of the Galapagian *Cactaceae* in the Herbarium of the Missouri Botanical Garden. In the citation of specimens under each species, the specimen is in the Herbarium of the California Academy of Sciences unless otherwise indicated.

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OPUNTIA

Introduction. Although the members of the genus *Opuntia* are among the most conspicuous floral features in the lowlands of the Galapagos Islands, the group has been one of the least understood from a taxonomic point of view. The reason for this is, of course, the meagre material prepared for study by the earlier explorers in the islands, explorers who, with a single exception, were nonbotanical in their major interests and who cannot be criticized for neglecting so difficult and time-consuming a task as the preparation of cactus specimens. So it is that in Robinson's *Flora of the Galapagos Islands* (1902) only five specimens of Galapagian *Opuntia* were known on which studies in the genus could be based. Stewart, as botanist of the California Academy of Sciences Expedition of 1905-1906, obtained a series of eighteen specimens in the genus, and while it was by far the best collection that had been made, it is to be regretted that specimens were not prepared on every island where he observed and studied plants growing. In this collection only one new species was distinguished and, due to incomplete specimens, the true floral characters of *O. galapageia* were confused and misinterpreted. This confusion was responsible in part for the course of Britton and Rose who recognized only a single species on the islands in their monographic study of the *Cactaceae* (1919), reducing the other species to synonymy. During the visit of the Templeton Crocker Expedition to the Galapagos Islands in the past year, a second large series of *Opuntia* totaling forty-two specimens was obtained for the Academy collection. Due to exceptionally favorable rains, the desert lowlands were blooming as had never before been seen by a botanist, and one of the advantages reaped was *Opuntia* in abundant flower and fruit.

As in the recent study of Galapagian *Mollugos*, what is attempted in this account of the genus *Opuntia* in the Galapagos Islands is as accurate and complete a taxonomic representation of this complex group as is possible at the present time. But as yet no collections are known from Bindloe, Chatham, Culpepper, Duncan, and Narborough islands (on all of which *Opuntias* have been recorded in field accounts), while from the large island of Albemarle, very inadequate collections have been made, so that with further exploration, a fuller picture of the genus will probably be attained. However a single specific complex as proposed by Britton and Rose is scarcely tenable in the light of the diverse floral and fruiting characters that have been disclosed, and the almost perfect geographic isolation afforded the several entities insures the relative morphologic stability which is believed to mark the species here presented.

KEY TO THE SPECIES OF *Opuntia*

- a. Fruit 1.5–5 cm. long, mostly rounded at the base, the ovary-cavity extending nearly or quite throughout the fruit at maturity.
 - b. Fruit without spines or with few, mostly inconspicuous spines; spines of branch-joints bristly or somewhat stiffish; north-central and northern islands.
 - c. Arborescent; perianth-segments less than 1.5 cm. long; fruit 1.5–2.5 cm. long; James, Jervis, and Abingdon islands.1. *O. galapageia*
 - c. Shrubby; perianth-segments 2 cm. long; fruit 3–5 cm. long; Tower and Wenman islands.2. *O. Helleri*
 - b. Fruit conspicuously spiny; spines of branch-joints rigid and stiff; Albemarle Island.
 - d. Perianth-segments 1–1.5 cm. long; areoles of branch-joints 1.5–2 cm. apart, very numerous; northern Albemarle Island.3. *O. insularis*
 - d. Perianth-segments 2–2.5 cm. long; areoles of branch-joints 2–3 cm. apart; southern and southwestern Albemarle Island.4. *O. saxicola*
- a. Fruit 5–17 cm. long, turbinate or obconic, the ovary-cavity filling only the upper part of the fruit at maturity.
 - e. Seeds more than 5 mm. long; spines of the branch-joints mostly bristly; arborescent; southern islands.5. *O. megasperma*
 - e. Seeds less than 5 mm. long; spines stiff and generally rigid; south-central islands.
 - f. Shrubby; spines 1 cm. or less long; North Seymour Island.6. *O. Zacana*
 - f. Arborescent; spines of branch-joints 2–13 cm. long; southern Albemarle, Indefatigable, Barrington, and South Seymour islands.7. *O. Echios*

1. *Opuntia galapageia* Hensl., Mag. Zool. and Bot.
1: 467 (1837)

Arborescent or subarborescent, 2.5–4 m. tall, always with a distinct trunk, the trunk to 2 m. tall and in mature specimens covered with flaky bark of ruddy-brown, the crown generally rather dense and rounded, the branches rarely drooping; branch-joints light green, elliptic or elliptic-obovate to round, 2.5–4 dm. long, 1.5–3 dm. wide; leaves not known; areoles 2–4.5 cm. apart, copiously filled with brown hairs and with very few or no glochids; spines varying from nonpungent bristles to acicular pungent spines, bright straw-yellow, generally more than 20 but rarely almost lacking, 3.5–6 cm. long; flowers small, perianth-segments about 1.3 cm. long (from Hensl., *loc. cit.*, pl. 14); fruit oblongish or round, 1.5–2.5 cm. long, 1.5–2.5 cm. in diameter, the fruit-areoles generally not spiny but with glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 2.5–4 mm. long.

Collections.—ABINGDON ISLAND: *Stewart No. 3001*. BARTHOLOMEW ISLAND: *Howell No. 10058*. JAMES ISLAND: James Bay, the region of the type locality, *Howell No. 9733*; north side, *Stewart No. 3012*; Sullivan Bay, *Howell No. 10006* and *10009* (trunk-joint). JERVIS ISLAND: near north end, *Howell No. 9783, 9784* (joints spineless), *9785*, and *9786* (trunk-joint); *Stewart No. 3013*. GALAPAGOS ISLANDS: *L. Agassiz in 1872* (Herb. Mo. Bot. Gard.).

Opuntia galapageia was not found in flower but from the very small size of the fruits it seems certain that the perianth-segments are small as they were originally described and figured by Henslow. In his studies in Galapagian *Cactaceae* (1911), Stewart confused *O. galapageia*, which he obtained neither in flower nor fruit, with the large-flowered species, *O. megasperma*, here described as new. Britton and Rose (1919) follow Stewart in misinterpreting the original description. The Agassiz specimen cited above was obtained on either James or Jarvis Island as can be determined from the account of the route of the *Hassler* in the Galapagos Islands (1875).

2. *Opuntia Helleri* K. Sch. in Rob., Proc. Amer. Acad.
38: 180 (1902)

Shrub, 0.3–2.5 m. tall, forming thickets 3–7 m. across, mostly without a distinct trunk; branch-joints pale yellowish-green or glaucous blue-green, elliptic to broadly oblanceolate, rather narrowly obtuse above and somewhat cuneate at the base, 2.5–3.5 dm. long, 1–1.8 dm. wide; leaves slender, 8–9 mm. long; areoles 2–3.5 cm. apart, with brown hairs and with few or no glochids; spines nonpungent bristles or stiffer and somewhat acicular, brown or yellowish-brown, generally 20 or more but rarely almost lacking, to 3–5 cm. long; flowers large, perianth-segments about 2 cm. long, yellow; fruit round to broadly oblong, 3–5.5 cm. long, 2–4 cm. in diameter, fruit-areoles with glochids and usually with 1, 2 or more spines, the ovary-cavity almost completely filling the fruit at maturity; seeds rather large, 4.5–6 mm. long.

Collections.—TOWER ISLAND: *Stewart No. 3005*; near Darwin Bay, *Howell No. 10099, 10100* (joints nearly spineless), *10101* (trunk-joints). WENMAN ISLAND: *Stewart No. 3006* (type locality).

Opuntia Helleri is mainly distinctive for its shrubby habit and bristly spines, large flowers and relatively small fruit. On Tower Island where the species was studied in the field, the plants grow in localized colonies, forming low dense thickets. When such thickets grow along the edge of rocky escarpments as they do on the east side of Darwin Bay, the stems hang in pendent masses 2 m. or more in length. On the bluffs of Wenman Island the species has the same pendent habit according to Stewart (1911, p. 113).

3. *Opuntia insularis* Stewart, Proc. Calif. Acad. Sci.,
4th ser., 1: 113 (1911)

Shrubby, 0.6–2 m. tall, or becoming arborescent and 3–4 m. tall, almost always with a distinct trunk, the trunk developing flaky ruddy-brown bark in age, the crown with few large joints; branch-joints dull green, ovate to oblong or oblong-elliptic, 3–5.5 dm. long, 2–3 dm. wide; leaves slender and pungently acute, 6–9 mm. long; areoles 1.5–2 cm. apart, prominently raised, copiously hairy, glochids numerous; spines rigid and pungent, sordid yellow, 2–4 cm. long, generally more than 25 in number; flowers small, perianth-segments yellow, 0.8–1.5 cm. long; fruit roundish, 2–4 cm. long, 2–3 cm. in diameter, the fruit-areoles with slender spines and glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 3–4 mm. long.

Collections.—ALBEMARLE ISLAND: Tagus Cove, *Stewart No. 3041* (type, C. A. S. Herb. No. 1275); Tagus Cove, *Howell No. 9516, 9601* (trunk-joints), and *9605*; summit of Tagus Cove Mt., 4000 ft., *Howell No. 9577, 9578* (young plant); east shore, 3 miles south of Equator, *Howell No. 9626*.

Opuntia insularis is a well marked and distinctive species readily distinguished from all other *Opuntias* on the islands by its rigid spines and small flowers, fruits, and seeds. It is also remarkable in the large joints, numerous areoles, and very long slender caudaceous leaves. The distribution of the species as it is now known on the northern part of Albemarle Island is a highly natural one. With future exploration to the southward it is not unlikely that forms intermediate between *O. insularis* and *O. saxicola* might be found and might even be expected in the vicinity of the Perry Isthmus. South of the isthmus *O. saxicola* appears to be the dominant species, at least on the west side of the island, as *O. insularis* is to the north.

An interesting phenomenon was observed in the orientation of the branch-joints of *O. insularis* growing on the slopes of Tagus Cove Mt. The branch-joints of an individual almost always grow in one plane so that a fan-shaped plant-crown is developed; and further, the crowns of all the plants tend to develop along parallel planes, so that in looking across the mountain slope one looks on the broad side of the cactus crowns, while in looking up or down the mountain one sees crowns only slightly wider than the thickness of the joints. This development of the crowns is probably the effect of a constant wind on the branch-joints, which are among the largest in the genus *Opuntia*. Exceptions to the prevailing scheme do occur but the whole effect is generally noticeable and impressive.

4. *Opuntia saxicola* Howell, spec. nov.

Plate 2, fig. 1

Fruticosa vel subarborescens, 1–3 m. alta, corona rotunda, trunco semper distincto, fere brevi, maturo cortice lamelliformi, ferruginea, ramis non pendulis; articulis ramorum viridibus vel griseo-viridibus, obovatis, ellipticis vel rotundis, 2.5–3 dm. longis, 2–2.5 dm. latis; foliis caducis 3.5–4 mm. longis; areolis 2–3 cm. separatim, lanuginibus fuscis, glochidiis; spinis subrigidis, pungentibus, ochraceis, ad 9 cm. longis, interdum sparsis, fere pluribus quam 20; floribus magnis, segmentis perianthii 2–2.5 cm. longis, citrinis; fructu late turbinato, basi vix angusto, 3–4 cm. longo, 2.5–3 cm. diametro, areolis fructuum glochidiis et spinis gracilibus, maturo fructu prope complito caverna ovarii; seminibus 3–3.5 mm. longis.

Shrubby or subarborescent, 1–3 m. tall, always with a distinct trunk but the trunk generally short, at maturity covered with flaky bark of ruddy-brown, the crown generally rounded, the branches not drooping; branch-joints light green or grey-green, obovate to elliptic and round, 2.5–3 dm. long, 2–2.5 dm. wide; leaves 3.5–4 mm. long; areoles 2–3 cm. apart, brown-hairy, with glochids; spines subrigid, pungent, brownish-yellow, to 2 or 3 (or to 9) cm. long, sometimes sparse but generally more than 20; flowers large, perianth-segments 2–2.5 cm. long, bright lemon-

yellow; fruit broadly turbinate, only slightly narrowed at base, 3–4 cm. long, 2.5–3 cm. in diameter, fruit-areoles with slender spines and glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 3–3.5 mm. long.

Collections.—ALBEMARLE ISLAND: near the shore on rather recent lava flow, five miles northeast of Webb Cove, *Howell No. 9453* (type, C. A. S. Herb., No. 200894), *9452* (joint with very long spines), *9454* (joint with very short spines), *9455* (trunk-joints); Villamil, *Howell No. 8963*.

Opuntia saxicola, with its small fruit filled with seeds at maturity, is probably nearest to *O. insularis* and these two species should perhaps be closely related to *O. galapageia*. On the coastal rocks of the southern part of Albemarle Island *O. saxicola* is the most abundant cactus and it is probably the only *Opuntia* on the southwestern coast. At Villamil on the southeast coast it is associated with *O. Echios* but on the lava pavements a short distance inland where specimens of the two species were obtained, plants of *O. saxicola* were much more numerous. It is not unlikely that the *Opuntia* forest traversed by the trail to Santo Tomas was of *O. Echios* but no specimens were obtained to settle this question. Also there are no specimens at hand to name the *Opuntia* reported by Stewart as growing at an elevation of 2,700 ft. in the crater of Villamil Mt. (1911, p. 113). A specimen of a seedling three joints high, collected at Villamil, *Howell No. 8964*, can be referred to *O. saxicola* since it grew in a nearly pure stand of this species. One specimen from South Seymour Island, *Howell No. 9918*, seems referable to *O. saxicola* but is an anomaly in the distribution of the species. Only one such plant was seen on South Seymour Island.

5. *Opuntia megasperma* Howell, spec. nov.

Arborescens vel raro fruticosa, 1–5 m. alta, corona rotunda, ramis adscendentibus densis compactisque, trunco fere distincto, 2–3 m. alta, 1 m. diametro, maturo cortice lamelliformi ferruginea; articulis ramorum viridibus, obovatis vel late oblanceolatis, 2–4 dm. longis, 1.5–2 dm. latis; foliis caducis, 7 mm. longis, acuminato-triangularibus; areolis 2–4 cm. separatim, lanuginibus copiosis fuscis, glochidiis nullis; spinis stramineis vel ochraceis, capillaro-echinatis vel 1–5 subrigidis, 30–40 vel spinis prope nullis, 2–3.5 cm. longis; floribus magnis, segmentis perianthii 2–3 cm. longis; fructu oblanceolato-turbinato vel obovato-turbinato, 5–17 cm. longis, 3–7.5 cm. diametro, areolis fructuum glochidiis nullis, caverna ovarii complenti solum superiore parte fructus maturi; seminibus 6–13 mm. longis, compressis vel crassiusculis et fere angularibus.

Arborescent or shrubby, 1–5 m. tall, generally with a distinct trunk, the trunk to 2 or 3 m. high and to 1 m. in diameter, in mature specimens covered with flaky, checkered bark of ruddy-brown, the crown rounded, densely and compactly branched, the branches ascending; branch-joints light green, obovate to broadly oblanceolate, 2–4 dm. long, 1.5–2 dm. wide; leaves 7 mm. long, acuminate-triangular; areoles 2–4 cm. apart, copiously filled with brown hairs, glochids lacking; spines straw-yellow to brownish-yellow, all bristly or with 1–5 stiffer spines intermixed, the bristly spines 30–40 or sometimes almost none, 2–3.5 cm. long; flowers large, perianth-segments 2–3 cm. long; fruit oblanceolate-turbinate to obovate-

turbinate, 5–17 cm. long, 3–7.5 cm. in diameter, fruit-areoles bristly but without glochids, the slender base of the fruit sterile at maturity; seeds 6–13 mm. long, compressed or thickened and somewhat angular.

Type of *Opuntia megasperma* Howell: Black Beach, Charles Island, *Howell No. 9360*, C. A. S. Herb. No. 200889.

Opuntia megasperma is remarkable in the genus *Opuntia* for the extreme sizes attained by diameter of trunk, length of fruit, and size of seed. The trunk of the largest specimen seen on Hood Island measured 2.9 m. in circumference or 0.92 m. in diameter, although Stewart (1911, p. 111) reports that extreme sizes of "as much as 4.5 ft." are reached. This is probably the thickest trunk attained by any *Opuntia* although it is approached by *O. Echios gigantea* in the cactus forests of Indefatigable Island in the vicinity of Academy Bay. The largest fruit seen is in the type of the species and measured 17.5 cm. in length and 5.5 cm. in diameter when fresh. Two fruits somewhat smaller measured 13 x 7.5 cm. and 9.5 x 6.5 cm. The thickened seeds found in the type are probably the most massive seeds in the genus. Only two species of *Opuntia* are recorded by Britton and Rose with seeds attaining a length of 10 mm., while in the type of *O. megasperma*, seeds 11–12 mm. long are not uncommon and the average length is at least 10 mm. This extreme diameter and thickness of seeds found in subspecies *typica* are due to the unusual development of the bony marginal band, and the irregularities of shape result from the crowded packing of the seeds within the ovary-cavity.

KEY TO THE SUBSPECIES OF *O. megasperma*

- Seeds 9–13 mm. broad, 5–9 mm. thick.....a. *typica*
 Seeds 6–8 mm. broad, 3–4 mm. thick.....b. *orientalis*

5a. *Opuntia megasperma typica* Howell, subspec. nov.

Segmentis perianthii ad 3.5 cm. longis; fructu 8–17 cm. longis; seminibus 9–13 mm. longis, 5–9 mm. crassis.

Perianth-segments to 3.5 cm. long; fruit 8–17 cm. long; seeds 9–13 mm. long, 5–9 mm. thick.

Collections.—CHAMPION ISLAND: *Stewart No. 2098*. CHARLES ISLAND: *Neboux in 1838* (Herb. Mo. Bot. Gard.); Black Beach, *Howell No. 9360* (type), *9361* (an old joint nearly spineless), *9362* (possibly the first branch-joint at top of trunk, with stiff and bristly spines intermixed), *9363* (trunk-joint); Black Beach, *Stewart No. 2099*; small crater south of Post Office Bay, *Howell No. 8845* (trunk-joint), *8846*; southeast side, *Stewart No. 3000*.

5b. *Opuntia megasperma orientalis* Howell, subspec. nov.

Segmentis perianthii ad 2.5 cm. longis; fructu 6–8 cm. longis; seminibus 6–8 mm. longis, 3–4 mm. crassis.

Perianth-segments to 2.5 cm. long; fruit 6–8 cm. long; seeds 6–8 mm. long, 3–4 mm. thick.

Collections.—GARDNER ISLAND (near Hood Island): *Howell No. 8784*; *Stewart No. 3002*. HOOD ISLAND: near Gardner Bay, *Howell No. 8725*, *8724* (trunk-joint); *Stewart No. 3003* (type, C. A. S. Herb., No. 50219); *Stewart No. 3004* (seedling).

6. *Opuntia Zacana* Howell, spec. nov.

Plate 2, fig. 2

Frutex, 1–1.5 m. (raro 2.5 m.) altus, trunco nullo, ramis patentibus et radicantibus; articulis ramorum viridibus, obovatis, basi nonnihil cuneatis, 3.5 dm. longis, 2.5 dm. latis; foliis caducis ignotis; areolis 2.5 cm. separatim, lanuginibus fuscis, glochidiis paucis; spinis brevissimis, rigidis, flavescentibus, ad 1 cm. longis, circa 10 paucioribusve; floribus ignotis; fructu turbinato, 5.5–8.5 cm. longis, 3.5–4.5 cm. diametro, areolis fructuum glochidiis sed spinis raris, paucissimis brevissimisque, caverna ovarii complenti parte solum superiore fructus maturi; seminibus 4 mm. longis.

Shrub, 1–1.5 m. tall (rarely to 2.5 m.), without a trunk, the branches spreading and rooting along the ground; branch-joints light green, obovate, somewhat cuneate at base, 3.5 dm. long, 2.5 dm. wide; leaves not known; areoles 2.5 cm. apart, filled with brown hairs and with few glochids; spines very short and rigid, pale yellow, to 0.8 or 1 cm. long, about 10 or fewer; flowers unknown; fruit turbinate, 5.5–8.5 cm. long, 3.5–4.5 cm. in diameter, fruit-areoles with glochids but only rarely with very few short spines, the cuneate base of the fruit sterile at maturity; seeds 4 mm. long.

Collection.—NORTH SEYMOUR ISLAND: *Howell No. 9957* (type, C. A. S. Herb., No. 200890).

This is the first truly shrubby *Opuntia* with stiff spines to be described from the Galapagos Islands. A short trunk is discernible only in very young plants but it is early concealed in the development of the bushy spreading habit. *Opuntia Zacana* is closely related to *O. Echios* of which it might be considered a subspecies if there were not such great differences in habit, spines, and fruit. Furthermore the habit and the characters of joints, spines, and fruits are nearly without variation, the species everywhere presenting a more uniform aspect than is found in any other Galapagian *Opuntia*. It is remarkable that *O. Zacana* on North Seymour Island is so very different from the *Opuntia* occurring on South Seymour Island and on the north side of Indefatigable Island. This new *Opuntia* further emphasizes the very local endemic cast which marks the florula of North Seymour Island.

In naming this species it is a pleasure to associate with it the name of the *Zaca*, the yacht of Mr. Templeton Crocker which was such an agreeable home during the six months of scientific exploration.

This also serves as an opportunity to express appreciation to the members of the party and especially to the crew of the *Zaca* for their helpful consideration of inconveniences attendant on the preparation of large botanical collections and especially their tolerance and coöperation during the trying preparation of the extensive series obtained in *Cactaceae*.

7. *Opuntia Echios* Howell, nom. nov.

Opuntia myriacantha Weber in Bois, Dictionn. d'Horticult. 894 (1898); Bull. du Mus. d'Hist. Nat. Paris 5: 313 (1899). Not *O. myriacantha* Link et Otto in Steud., Nom., ed. 2, 2: 221 (1841).

Arborescent, 2-8 m. tall, always with a distinct trunk, the trunk to 4 m. tall, and in mature specimens covered with brown flaky bark, the crown rather irregularly and openly branched, the branches sometimes drooping; branch-joints light green, elliptic to narrowly obovate, 3-5 dm. long, 1.5-2.5 dm. wide; leaves 3 mm. long; areoles 2-3 cm. apart, filled with brown hairs and glochids; spines varying from acicular to slender-subulate and rigid, pungent, straw-yellow to brownish-yellow, generally 15-20 or rarely lacking, generally to 5 or 6 cm. long or to 13 cm. long; flowers large, perianth-segments 2.5 cm. long; fruit turbinate, 5-9 cm. long, 3-4 cm. in diameter, fruit-areoles with acicular spines and glochids, the narrowed base of the fruit sterile at maturity; seeds 3-4 mm. long.

Opuntia Echios is the arborescent *Opuntia* of the Galapagos Islands with stiff spines and large flowers and fruits. The original identity of Weber's species, *O. myriacantha*, is not certain. His first description published in 1898 is obviously taken from a growing plant with no flowers and from the characters described it is not possible to distinguish the plant from the several species in the Galapagos Islands. Moreover no specimens were cited which can serve to identify the name. The second and more ample account published by Weber in 1899 is also taken from a growing plant which bore flowers and fruits, and two specimens are cited which were intended to be representative of the species. Because of the incompleteness of the first description, the second description which definitely places the species is here accepted as the one on which *O. myriacantha* Weber is established.

The first specimen cited by Weber in the second description is the collection made by Neboux in 1838 which, according to Weber, was taken on Charles Island, but since *O. myriacantha* Weber has not since been detected on that island, the specimen would appear to have been either misdetermined or misplaced. The material of Neboux' collection in the Herbarium of the Missouri Botanical Garden which has been available for study through the kindness of Dr. J. M. Greenman consists only of fascicles of spines. Fragments of bark adhere to several of the fascicles so it is evident that the spine-bundles are from trunk-joints, and a close examination of the pad of copious brown hairs at the base of the spines discloses the

complete absence of glochids. This fact almost positively places the material as *O. megasperma*, for, among the other unusual characters of that species, the nearly or quite complete suppression of glochids is to be counted. Examination of the trunk-joints of all the other species in the islands discloses the presence of glochids in the trunk-areoles of each. So in this work the Neboux collection is referred to typical *O. megasperma* of Charles Island.

The second specimen cited by Weber in the later description, as well as the living plant on which the second description is based, were from the collection made by Louis Agassiz on the Hassler Expedition in 1872, material said to have been collected on Albemarle Island. But an examination of the route of the *Hassler* while in the Galapagos Islands (1875) shows that the only stop made on Albemarle Island was at Tagus Cove where it is quite certain no *Opuntia* grows except *O. insularis* Stewart. That *O. insularis* is not the same as *O. myriacantha* Weber is apparent from the description of the flowers and fruit of the latter species, *O. insularis* having small flowers and globular fruit, *O. myriacantha* being described with large flowers and obconic fruit. Furthermore the narrative of the Hassler Expedition (1875) states that after leaving Jervis Island on June 16, the following days were spent on Indefatigable Island before sailing for Panama on June 19. This means that the Hassler Expedition visited Conway Bay on the northwest side of Indefatigable Island which, with Post Office Bay, Tagus Cove, and James Bay, was one of the usual anchorages. Undoubtedly it was at Conway Bay where Agassiz collected the specimens of *O. myriacantha* Weber, the flowers and fruit of which according to Weber so well correspond to the flowers and fruits of the plants abundant near the shore of the anchorage. It is interesting however that the Agassiz specimen in the Herbarium of the Missouri Botanical Garden is a roundish joint 9 cm. long, smaller than any normal joints seen from the islands, and the areoles are even nearer together than are the areoles in *O. insularis*. It would appear that Weber preserved no material from the living plant he described, a conjecture supported by a communication concerning some of Weber's material from Monsieur H. Humbert at the Museum National d'Histoire Naturelle of Paris.

Because of the element of uncertainty which accompanies the cited specimens of *O. myriacantha* Weber and because it seems desirable to establish beyond doubt the new name proposed here, a type is definitely named from Conway Bay on the northwest side of Indefatigable Island. The giant *Opuntia* of the south side of Indefatigable Island is indicated as a subspecies with the appropriate name *gigantea*.

Type of *Opuntia Echios* Howell: Conway Bay, Indefatigable Island, Howell No. 9847, C. A. S. Herb., No. 200895 and 200896.

KEY TO THE SUBSPECIES OF *O. Echios*

- Branches not noticeably drooping; spines of branch-joints becoming 11–13 cm. long, rigid. a. *typica*
 Branches generally drooping; spines of branch-joints generally 2–3.5 cm. long, acicular. b. *gigantea*

7a. *Opuntia Echios typica* Howell, nom. nov.

Plate 3, fig. 3

Opuntia myriacantha Weber, loc. cit.*Opuntia* sp. Stewart, Proc. Calif. Acad. Sci., ser. 4, 1: 115 (1911).

Crown not loosely or openly branched, the branches not noticeably pendant; branch-joints 3–5 dm. long, about 2 dm. wide; spines of branch-joints reaching 11–13 cm. long, stiff or rigid.

Collections.—INDEFATIGABLE ISLAND: Conway Bay, *Howell No. 9847* and *9848*; *L. Agassiz in 1872* (perhaps a young trunk-joint, Herb. Mo. Bot. Gard.). SOUTH SEYMOUR ISLAND: *Stewart No. 3015*; middle western part, *Howell No. 9919*.

Besides the collection cited above from South Seymour Island, a specimen representative of most of the plants of the island, two other collections were made on the island which deserve special mention. One, *Howell No. 9920*, has narrow oblongish joints and elongate fruit in which the ovary-cavity is centrally placed with sterile tissue above and below, the only fruit of the sort found on the Galapagos Islands. Until it can be studied further the form is referred to typical *O. Echios* to which it is most nearly allied. Only a single plant of this variation was seen. The second collection from South Seymour Island deserving particular mention is *Howell No. 9918*, from a plant which differed from all others seen on the island in its low shrubby habit, short spines, and short fruit in which the ovary-cavity extends nearly to the base of the fruit leaving almost no sterile tissue. These characters, which would be incongruous in *O. Echios*, definitely belong to *O. saxicola* of Albemarle Island and the plant is tentatively referred to that species as an anomaly in distribution.

7b. *Opuntia Echios gigantea* Howell, subspec. nov.

Plate 3, fig. 4

Ramis coronae fere patentibus, laxis, pendulisque; articulis ramorum circa 3 dm. longis, 2 dm. latis, spinis acicularibus, 2–3 cm. longis, fere sparsis vel nullis.

Crown rather loosely and openly branched, the branches generally more or less pendant, sometimes drooping to the ground; branch-joints about 3 dm. long and 2 dm. wide; spines of branch-joints acicular, 2–3 cm. long, generally sparse, sometimes lacking.

Collections.—ALBEMARLE ISLAND: Villamil, *Stewart No. 3008*; near Villamil, *Howell No. 8962* (joints nearly spineless). BARRING-

TON ISLAND: *Stewart No. 3007*. INDEFATIGABLE ISLAND: Academy Bay, *Stewart No. 3009, 3010*; Academy Bay, *Howell No. 9112* (type, C. A. S. Herb., No. 200893), *9111* (trunk-joint), and *9113*; southeast side, *Stewart No. 3011* (young plants).

This form of *O. Echios* is to be counted among the tallest species in *Opuntia*. Plants are commonly 3–4 m. tall wherever they occur but at Academy Bay on the south side of Indefatigable Island, trees 6–8 m. (or perhaps even 10 m.) tall are not infrequent. These trees are impressive and grotesque features of the landscape with their few ponderous and jointed branches pendant even to the ground.

CEREUS

Introduction. From the evidence at hand, which includes a series of fifteen specimens obtained on the Templeton Crocker Expedition, it would seem that the specific names used by Britton and Rose (1920) for the two Galapagian cacti of the *Cereus*-relationship are not correct. From the evidence obtained in the field supplemented by extensive collections, it has been possible to interpret the older and rather meager specimens and descriptions in a way which would not be possible except through a perfect intimacy bred in the field. Furthermore it seems evident that the two *Cereus*-like plants of the Galapagos Islands are representative of two distinct generic types, but without a wide and intensive study of the numerous genera segregated from *Cereus*, it is not possible here to confirm *Jasminocereus* and *Brachycereus*, the two monotypic and endemic genera proposed by Britton and Rose for the Galapagian species (1920). Since just now there is not time for as detailed a study as the situation requires, the plants are again referred to the old and broadly conceived genus *Cereus* with the specific names believed to be correct.

KEY TO THE SPECIES OF *Cereus*

- Arborescent, plants generally with a distinct trunk, attaining a height of 8–10 m.; stem with 12–18 ribs, generally 13–16; perianth-tube and fruit without spine-bundles; seeds finely tuberculate... 1. *C. Thouarsii*
Subcaespitose, the stems erect, 0.3–0.6 m. long, sometimes as many as 300 in a colony; stem with 17–22 ribs, generally 20 or 21; perianth-tube and fruit stellate-spiny; seeds quite smooth... 2. *C. nesioticus*

1. *Cereus Thouarsii* Weber, Bull. Mus. d'Hist. Nat.
5: 312 (1899)

C. galapagensis Weber, *loc. cit.*

C. sclerocarpus K. Sch. in Rob., Proc. Amer. Acad. 38: 179 (1902).

Jasminocereus galapagensis (Weber) B. & R., Cactaceae 2: 146 (1920).

Not *Brachycereus Thouarsii* B. & R., Cactaceae 2: 120 (1920).

Collections.—GALAPAGOS ISLANDS: *L. Agassiz in 1872* (photographs of specimen, Herb. Mo. Bot. Gard.). ALBEMARLE ISLAND:

5 miles northeast of Webb Cove, *Howell No. 9457*; east side, 3 miles south of Equator, *Howell No. 9628*; Villamil, *Stewart No. 2095*. CHARLES ISLAND: near Post Office Bay, *Howell No. 8847*; Black Beach, *Howell No. 8916*; *Stewart No. 2090*. CHATHAM ISLAND: Wreck Bay, *Stewart No. 2091*. INDEFATIGABLE ISLAND: Academy Bay, *Howell No. 9296*, *Stewart No. 2096*; Conway Bay, *Howell No. 9849*. JAMES ISLAND: James Bay, *Howell No. 9734*, *Stewart No. 2097*; Sullivan Bay, *Howell No. 10007*.

Both the specimen cited by Weber and the data given by him from the record of Du Petit-Thouars indicate that *Cereus Thouarsii* is the arborescent *Cereus* of the Galapagos Islands. Weber's description of the fruit (after Du Petit-Thouars, 1841) is exactly that of the arborescent *Cereus*. The Engelmann data mentioned by Weber are based on the specimen collected on the Hassler Expedition, photographs of which have been available for study from the Herbarium of the Missouri Botanical Garden. These photographs show a relatively low cylindrical stem, clothed with stiff, somewhat divaricate spines which are not so dense but that the ribs are easily discernible between them. It is evident that there are only 7 rows of spines visible on the half of the stem exposed to view, or, at most, 14 rows of spines in the whole circumference. Since in *C. nesioticus* K. Sch. there are usually 20 or more rows of spines (very rarely 17 or 18), and since the spines are always so dense that ribs can never be seen in that species, it seems undeniable that the photographs are of a young specimen of *C. Thouarsii* Weber and not *C. nesioticus* K. Sch., names considered synonymous by Britton and Rose. This conclusion is borne out by a comparison of the photographs with *Howell No. 8916*, a specimen of a young plant of *C. Thouarsii* collected on Charles Island. No specimen of *C. nesioticus* in the large series seen from the islands resembles the photographs which, in the absence of other material, must serve as the basis for the identity of *C. Thouarsii*.

2. *Cereus nesioticus* K. Sch. in Rob., Proc. Amer. Acad.
38: 179 (1902)

Brachycereus Thouarsii B. & R., Cactaceae 2: 120 (1920), not *Cereus Thouarsii* Weber, Bull. Mus. d'Hist. Nat. 5: 312 (1899).

Collections.—ABINGDON ISLAND: south side, *Stewart No. 2092*. ALBEMARLE ISLAND: 5 miles northeast of Webb Cove, *Howell No. 9456*. JAMES ISLAND: James Bay, *Howell No. 9709*; Sullivan Bay, *Howell No. 10008*. NARBOROUGH ISLAND: northeast side, *Howell No. 9607*, *9608*, *Stewart No. 2093*; southeast side, *Howell No. 9630*, *9631*, *9631A*. TOWER ISLAND: *Stewart No. 2094*.

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